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1905. In that year the death-rate for the city of Panama was 65.82 per 1,000; its population had risen from 21,984 in 1905 to 40,801 in 1909, but the death-rate had fallen to 25.44 per 1,000. In the Canal Zone, including the cities of Colon and Panama, the population has risen from 56,624 in 1905 to 135,180 in 1909, but the death-rate has fallen from 49.94 to 18.19 per 1,000. Among the employees, who numbered 16,511 in 1905 and 47,167 in 1909, the death-rate has fallen from 25.86 to 10.64 per 1,000. In 1905 the number of patients admitted to the hospitals for malaria alone was 514 for every 1,000 employees, and in 1906 it rose to 821; but in 1909 it had fallen to 215 for each thousand employees. These astonishing results reflect infinite credit on the sanitary department of the Isthmian Canal Commission, and they also point to the almost incalculable benefits, actual and potential, derived by mankind from sustained bacteriological research. It is true that they have involved the extirpation, not perhaps always by painless methods, of countless myriads of mosquitoes and other small deer—some of them possibly vertebrate; and for all we know this may be, as it logically ought to be, a source of infinite pain to the more extreme of the antivivisectionists. But after all we may ask them with the distinguished American quoted by Lord Cromer, "At how many rabbits or guinea pigs do you value your wife, your husband or your child?" That, as Lord Cromer said, puts the case in a nutshell. For without experiments on living animals there can be very little advance in bacteriology.—*The London Times*.

SCIENTIFIC BOOKS

Experiments on the Generation of Insects.

By FRANCESCO REDI. Translated from the Italian edition of 1688 by MAB BIGELOW. 8vo, pp. 160, illustrated. Chicago, The Open Court Publishing Co. 1909.

The appearance in 1668 of Redi's "Esperienze Intorno alla Generazione Degli Insetti" was a notable scientific event. This book embraced the first published results of experiments to determine the truth or falsity of an

old scientific dogma, and it remains as a milestone on the highway of biological progress. By supplying an attractive edition of this biological classic the translator (Mab Bigelow) has rendered a service to biologists and to others with intellectual interests in the progress of human thought. The translation is from the fifth Italian edition of 1688 and contains photographic reproductions of the title page and of all the illustrations. These consist of twenty-nine plates, and twelve other cuts in the form of text-figures and full-page illustrations, in some cases, with several figures to one cut. The pictures are *fac-simile* except as to size—most of them having undergone some reduction to fit the dimensions of the volume—and it is a satisfaction to have the entire work so well reproduced.

In Redi's time the belief that living forms arise spontaneously from lifeless matter through the action of natural forces was of long standing. This was according to the teachings of Aristotle and it had scarcely been questioned before the experimental tests of Redi. At the time of the publication of the first edition of his book the microscopic organisms were unknown and the doctrine of spontaneous generation of life was held for relatively large animals as frogs, mice, insects, etc. As one of the writers of the period said, "To question this is to question reason, sense and experience." The great service of Redi was to replace this belief in abiogenesis by that of biogenesis, or life only from previously existing life.

Redi's book is a long letter addressed to Carlo Dati, in which he pleads for the experimental method, and, after a review of the opinion of earlier writers, with many modest protestations, he describes his experiments and conclusions. He says (p. 33):

Belief would be vain without the confirmation of experiment; hence in the middle of July I put a snake, some fish, some eels of the Amo and a slice of milk-fed veal in four large, wide-mouthed flasks; having well closed and sealed them [*con carte e spagi*, as another edition says], I then filled the same number of flasks in the same way, only leaving these open. . . .

Maggots appeared in the open flasks to

which flies had free access, but no visible form of life appeared within the meat in the closed flasks, although an occasional egg or maggot was deposited upon the paper that covered them. After a long digression Redi continues (p. 36):

I thought I had proved that the flesh of dead animals could not engender worms unless the semina of live ones were deposited therein, still, to remove all doubt, as the trial had been made with closed vessels into which the air could not penetrate or circulate, I wished to attempt a new experiment by putting meat and fish in a large vase closed only with a fine Naples veil, that allowed the air to enter.

Under these conditions he found the meat remaining free from maggots or other forms of life visible to the unaided eye. The results of these simple and homely experiments, together with the reasoning of Redi, served to change the belief in the occurrence of spontaneous generation of life. It is true that after the discovery of microscopic organisms the question had to be tested with especial reference to these minute forms of life, but the experiments of Redi stand as the first published ones to make a scientific onset against the ancient dogma. The book is of varied contents and, naturally, all parts of it are not of equal interest and significance. His long disquisition on the origin of bees is discursive and tiresome. His letter embraces observations and comments on the poison of scorpions, on spiders, cheese worms, fruit flies, frogs, grafting experiments, galls, silk-worms, butterflies, lice, etc. In reference to galls, he concludes that nature produces the gall for the generation of the insect, and that the fly that proceeds from the gall arises not from an animal egg, but from the modified tissues of the plant. One rather amusing circumstance is his testing on a human being the effect of meat poisoned by the sting of a scorpion. He says (p. 61):

Having had frequent proof that animals killed by a snake's bite, or tobacco, which is a terrible poison, can be eaten with impunity, I gave these pigeons to a poor man, who was overjoyed, and ate them with great gusto, and they agreed with him very well.

The book is well translated and the Italian

is rendered into the equivalents of modern science—as *tossico*, translated toxin (p. 48) and *uova*, translated variously egg and pupa, according to the context. The bibliographical references to Redi and his work are not especially well chosen. Even so brief a list might be improved by making a few substitutions. One misses especially reference to Guiart's article on Redi in the first volume of the *Archives de Parasitologie*, and to Huxley's analysis of Redi's "Esperienze" in his address before the British Association at Liverpool in 1870. These might be substituted for the references to Cuvier and to Pouchet. Guiart's article contains a very fine portrait of Redi. The fine edition of Redi's works in nine volumes, Milan, 1809–11, also contains a well-written life of Redi and an attractive portrait. In this edition the "Esperienze Intorno alla Generazione Degli Insetti," although essentially the same, is somewhat fuller than in the edition of 1688. It should be noted, however, that in the edition of his complete works, the illustrations of the "Esperienze" are engraved on a smaller scale and do not in any sense equal the photographic reproductions in the present volume.

The growing interest in the historical phases of biological investigation makes the appearance of this volume timely and we predict for it a deservedly wide circulation.

WILLIAM A. LOOY

EDUCATION A NATIONAL FUNCTION¹

THE condition of American education to-day is in many respects a national reproach. In no other nation claiming to be civilized is there at the present time so large a population in such educational degradation as the American negro. No other population, equally numerous, to be found within the limits of any civilized nation so deprived of educational facilities and opportunities.

If there is any situation in our present society, for which the nation as a whole is responsible, surely the condition of the Amer-

¹ Abstract of an address by Dr. Edmund J. James, president of the University of Illinois, before Minnesota Teachers' Association in St. Paul, Minnesota, November 3, 1910.